Disposable filter cartridge for medical and domestic use

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Inventor: GRAUS ANDREAS (DE); SCHAEFER CHRISTIAN (DE)
Applicant: SARTORIUS GMBH (DE)
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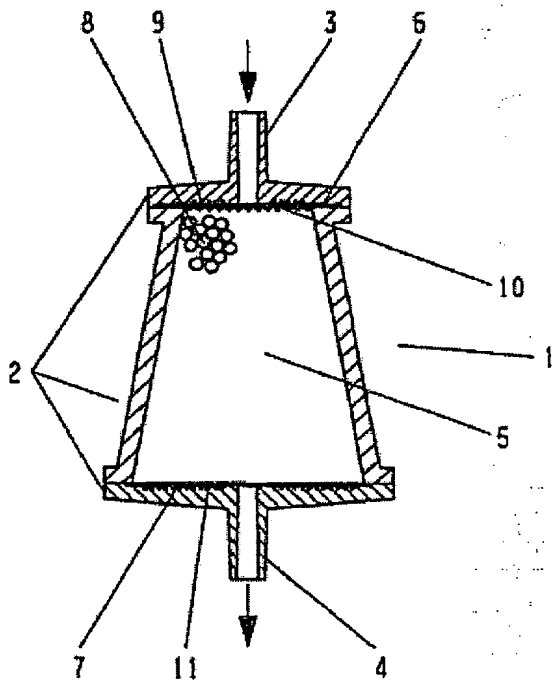
Abstract of **DE19816871**

Disposable filter cartridge combines filter cloths at the inlet and outlet stubs with granular adsorbent in the body of the cartridge. The filter cartridge can be used for gases or liquids and is particularly designed for clinical or laboratory use. Filter membranes (6,7) are stretched across the inlet and outlet stubs (3,4) specifically to retain microorganisms and andotoxins. The body of the cartridge is filled with adsorbent granules, such as activated charcoal, and has the shape of a frustum of a cone to prevent bypass of the medium at the walls. Thus there is reduction of area of about 10% between the two ends. Membranes will have a pore size between 0.2 and 0.5 mu m. The membrane (7) at the exit will have the smaller pore size. Membranes of hydrophobic material are used to handle gases. Hydrophilic material is used to handle liquids. The chamber (5) will be at least 1.5 mm long. Granules are packed to occupy between 97 and 99% of the chamber and their particle size will be between 0.7 and 1.5 mm. Such a cartridge will pass 2000 ml air per minute at a pressure difference of 0.1 bar.



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Description

The invention relates to a filtration unit for removing harmful substances from fluids such as liquids and gases by means of particle adsorbent, in particular by means of active carbon particles.

The filtration units according to the invention are usable in rooms with particular safety and cleanliness requirements, such as operating theatres of clinics to adsorb harmful gases that occur for example when mixing bone glue; in laboratories, for example to scrub carrier gases for analysis equipment; for filtering liquids to remove contaminants that for example need to be examined by diagnosis kits. Such filtration units can be used as disposables and can be disposed of together with the adsorbed harmful substances.

From US-PS 4 064 876 a filter unit is known that is configured as a filtration cartridge that possesses a portion of active carbon particles between a polyurethane foam layer and a glass fibre layer. The active carbon particles should be pressed together by the two layers in such a way that the loose portion can move as little as possible. In this way the creation of cavities can be avoided via which fluid (air) filled with harmful substances would enter unhindered. The drawback is that high passage resistance is opposed to the fluid, which leads to a diminution of filter performance. As an alternative to this, it is also suggested to finely distribute the active carbon particles in a coarse glass fibre fleece. However, the drawback is that the active carbon particles that are only kept in position loosely between the glass fibres become worn over time and are flushed out of the fleece as dust. The filtrate is thus contaminated and undesired bypasses are created whereby the adsorption capacity of the filter cartridge is diminished.

The object of the invention therefore consists of creating a filtration unit for the removal of harmful substances from fluids using adsorbing particles that ensures high filtration and adsorption performance and whereby bypasses and contamination of the filtrate are avoided.

The object is achieved through a filtration unit that consists of housing that is provided at the front with opposite inlet and outlet connection pieces whereby the connection pieces are separated from the housing space by flat filter positions and the housing space contains a portion of adsorber particles so that the fluid to be filtered, according to the inlet connection piece, has to pass the first flat filter position, the adsorber particles, the second flat filter position and the outlet connection piece. The housing space is thereby filled approximately 99% and 97% with the adsorber particles and is narrowed in at least one section, whereby the flat filter positions are arranged with central symmetry to one another. Narrowing is present in such a way that the volume of the housing space is reduced by at least 5% approximately, preferably by approximately 10% in comparison with the volume of a housing space without such narrowing.

By narrowing the housing space and the central symmetrical arrangement of the two flat filter positions the filtration unit can be operated in any desired position and no bypass can be formed between the portion of adsorber particles and the wall of the housing, which the fluid to be filtered can pass without adsorption. Through filling of the housing space with a portion of the adsorber particles that take up between 97% and 99% of the housing volume a high flow of the fluid that is to be filtered is assured.

In preferred embodiments of the invention the housing space is configured in the narrowing sections as a truncated cone or truncated pyramid.

In an alternative embodiment of the invention the flat filter

positions arranged centrally symmetrically in relation to one another differ in size by at least 5%, preferably by at least 10%. In this embodiment narrowing of the housing space is not necessary.

In order to remove harmful substances from gases the flat filter positions consists of hydrophobic materials and of hydrophilic materials for the removal of harmful substances from watery solutions, preferably from corresponding porous membranes. For filtration it has been found to be sufficient for the flat filter positions to have a pore diameter of between 0.2 to 0.5µm, preferably of 0.2µm. Such hydrophobic membranes allow for example an air flow of at least 3 litres per minute and cm^2 at 0.1 bar pressure difference. Furthermore, membranes within the aforementioned pore size range quantitatively practically hold back microorganisms and wear to the adsorber particles. Polytetrafluorethylene (PTFE) membranes are preferred as hydrophobic membranes. For the removal of harmful substances from gases, hydrophobic membranes simultaneously act as liquid barriers and protection for subsequent equipment that is sensitive to damp such as pumps, analysis equipment, etc. In order to increase filtration, a membrane with pore diameter of more than 0.5µm can be used for the first flat filter position on the inlet side.

Modified polyethersulphone, polyamide, cellulose acetate and cellulose hydrate membranes (Hydrosart®, Sartorius AG) have proved themselves particularly. In a preferred embodiment of the invention the hydrophilic membranes consist of porous membrane adsorbers, for example in the form of ion exchanger membranes. According to WO-A1-02/00805 (Sartorius AG) porous membrane adsorbers are membranes that carry functional groups, ligands or reactants on their inner and outer surfaces that are enabled for an exchange with at least one substance of a fluid phase that is in contact with it. With such an embodiment of the invention it is possible to bind specific harmful

substances into the membrane adsorbers that are either not bound by the adsorber particles or where the membrane adsorbers act as an additional safety filter (police filter), for example for ensuring the separation of endotoxins on membrane adsorbers (DE-OS 195 43 371).

In a preferred embodiment of the invention, the flat filter positions are supported. It is generally sufficient for at least one of the flat filter positions to be supported, preferably the second flat filter position near the outlet connection piece. The outlet connection piece can itself be configured as the filter support.

The adsorber particles are selected according to adsorption task. Active carbon is often used. Active carbon particles normally have a specific inner surface of 500 to over 2000 m^2/g (BET determination method). It is thus able to unspecifically bind a large number of substances permanently or reversibly. However, as also the outer surface of the active carbon particles influences adsorption kinetics, active carbon with granulometry of between 0.1 and 1.7mm is preferably used. In order to ensure adequate adsorption in the housing space, the portion should have a height (adsorption length) of at least 1.5cm.

The invention will now be explained in greater detail on the basis of the drawings and the example embodiment.

Figure 1 shows a schematic vertical cut through an embodiment of a filtration unit according to the invention with complete narrowing of the housing.

Figure 2 shows a schematic vertical cut through a further embodiment of a filtration unit according to the invention with two narrowing sections of the housing and

Figure 3 shows a schematic vertical cut through an alternative embodiment of a filtration unit according to the invention with filter positions of different sizes.

According to **Figures 1** to **3** the filtration unit **1** consists of a

housing **2** that is frontally provided with an opposite inlet connection piece **3** and outlet connection piece **4**. The connection pieces **3**, **4** are separated from the housing space **5** by a first **6** and a second flat filter position **7** that covers them. The housing space **5** contains a portion of adsorber particles **8**. The housing space **5** is shown in **Figure 1** as a truncated cone, in **Figure 2** with two narrowing sections configured as truncated cones and in Figure **3** as a cylinder. The first flat filter position **6** is supported on both sides in **Figure 1** and on one side in **Figures 2** and **3**. Paths of fluid distribution channels **9** that are arranged on the surface of the inlet connection piece **3** facing the flat filter position **6** act as filter support and on the other hand in accordance with **Figure 1** additionally on the side of the flat filter position **6** that faces the housing space **5** an additional filter support **10**, for example in the form of a grid, web or fleece is arranged. Similarly, paths of fluid collection channels 11 of the outlet connection piece 4 act as filter support.

According to **Figure 3**, the active filter surface of the first flat filter position **6** arranged on the inlet side is at least 5% less than the active filter surface of the second flat filter surface **7** on the outlet side.

The filtration unit **1** can be operated in both directions. The direction in which it is used is unimportant for successful filtration.

Example embodiment

A filtration unit manufactured according to **Fig. 1** and equipped with 0.2µm PTFE membranes (active first membrane surface 5.5 cm^2, active second membrane surface 1.4 cm^2), that has a portion of 2.5g active carbon with granulometry of 0.7 to 1.5mm of the Adako-Pica company, has a flow rate of air fluid of 2000 ml per minute at a pressure difference of 0.1 bar.

CLAIMS

1. Filtering unit (1) for removing harmful substances from fluids consisting of a housing (2) the front of which is provided with an inlet (3) located opposite and an outlet-connection piece (4), wherein the connection pieces (3, 4) are separated from the housing chamber (5) by flat filter positions (6, 7) that cover them and the housing chamber (5) contains a supply of adsorber particles (8) so that the fluid to be filtered, as determined by the inlet-connection pieces (3), has to pass through the first flat filter position (6), the adsorber particles (8) have to pass through the second flat filter position (7) and the outlet-connection piece (4), characterised in that the housing chamber (5) is filled to between 97 and 99% with the adsorber particles (8) and has a narrowing configuration in at least one stretch so that its volume is reduced by the narrowing by at least 5, preferably by at least 10% compared with the volume of a housing chamber (5) without such a narrowing and the flat filter positions (6, 7) are arranged centrally symmetrically to one another.

2. Filtering unit according to claim 1, characterised in that the housing chamber (5) in the narrowing stretch is shaped as a truncated cone or as a truncated pyramid.

3. Filtering unit (1) for removing harmful substances from fluids consisting of a housing (2) the front of which is provided with an inlet- (3) and an outlet-connection piece (4) located opposite each other, wherein the connection pieces (3, 4) are separated from the housing chamber (5) by flat filter positions (6, 7) that cover them and the housing chamber (5) contains a supply of adsorber particles (8) so that the fluid to be filtered, as determined by the inlet-connection pieces (3), has to pass through the first flat filter position (6), the adsorber

particles (8) has to pass through the second flat filter position (7) and the outlet-connection pieces (4), characterised in that the housing chamber (5) is filled to between 97 and 99% with the adsorber particles (8) and has a narrowing configuration in at least one stretch so that its volume is reduced by the narrowing by at least 5, preferably by at least 10% compared with the volume of a housing chamber (5) without such a narrowing and the flat filter positions (6, 7) are arranged centrally symmetrically to one another.

4. Filtering unit according to claims 1 to 3, characterised in that the flat filter positions (6, 7) for removing harmful substances from gases consist of hydrophobic membranes.

5. Filtering unit according to claim 4, characterised in that the hydrophobic membranes consist of polytetrafluorethylene.

6. Filtering unit according to claims 1 to 3, characterised in that the flat filter positions (6, 7) for removing harmful substances from water solutions consist of hydrophilic membranes.

7. Filtering unit according to claim 6, characterised in that the hydrophilic membranes have membrane adsorbers.

8. Filtering unit according to claims 3 to 7, characterised in that the membranes have a pore diameter in the range of 0.2 to 05 µm, preferably of 0.2 µm.

9. Filtering unit according to claims 1, 3 and 8, characterised in that the first flat filter position covering the inlet-connection piece has a greater pore diameter than the second flat filter position 10.

10. Filter unit according to the above claims, characterised in that at least one of the flat filter positions (6, 7) is supported on one or both sides.

11. Filter unit according to claim 10, characterised in that the outlet-connection piece (8) is configured as a filter support (11).
12. Filter unit according to the preceding claims, characterised in that the adsorbent particles (8) consist of activated coal.
13. Filter unit according to claim 12, characterised in that the activated coal (8) has a particle size between 0.7 mm and 1.5 mm and the housing chamber (5) is at least 1.5 cm in length.